FIG. 1

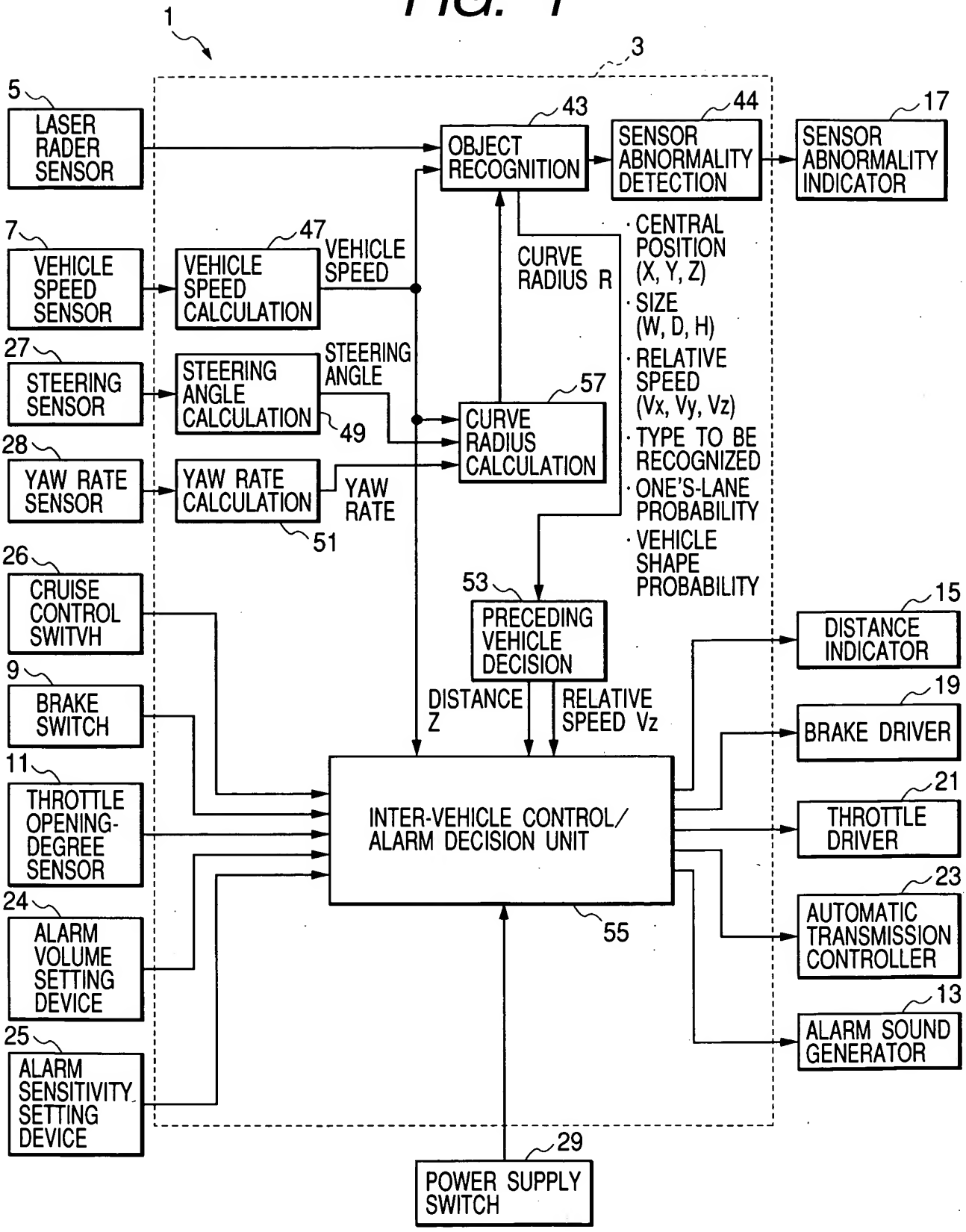
1
3
5
LASER RADER SENSOR
43
OBJECT RECOGNITION
44
SENSOR ABNORMALITY DETECTION
17
SENSOR ABNORMALITY INDICATOR
7
VEHICLE SPEED SENSOR
47
VEHICLE SPEED CALCULATION
VEHICLE SPEED
CURVE RADIUS R
· CENTRAL POSITION (X, Y, Z)
· SIZE (W, D, H)
· RELATIVE SPEED (Vx, Vy, Vz)
· TYPE TO BE RECOGNIZED
· ONE'S-LANE PROBABILITY
· VEHICLE SHAPE PROBABILITY
27
STEERING SENSOR
STEERING ANGLE CALCULATION
STEERING ANGLE
49
57
CURVE RADIUS CALCULATION
28
YAW RATE SENSOR
YAW RATE CALCULATION
YAW RATE
51
26
CRUISE CONTROL SWITVH
53
PRECEDING VEHICLE DECISION
15
DISTANCE INDICATOR
9
BRAKE SWITCH
DISTANCE Z
RELATIVE SPEED Vz
19
BRAKE DRIVER
11
THROTTLE OPENING-DEGREE SENSOR
INTER-VEHICLE CONTROL/ ALARM DECISION UNIT
21
THROTTLE DRIVER
24
ALARM VOLUME SETTING DEVICE
55
23
AUTOMATIC TRANSMISSION CONTROLLER
25
ALARM SENSITIVITY SETTING DEVICE
13
ALARM SOUND GENERATOR
29
POWER SUPPLY SWITCH

FIG. 2A

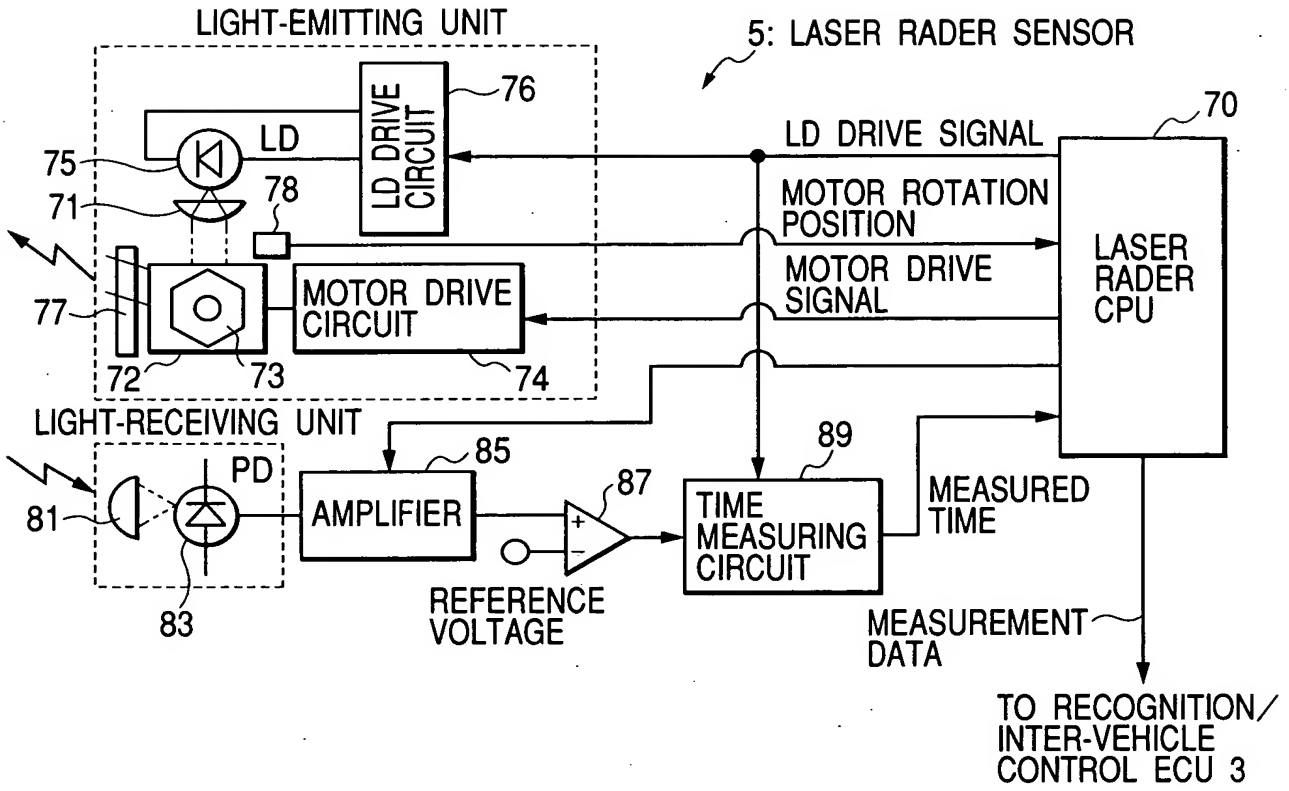
LIGHT-EMITTING UNIT
5: LASER RADER SENSOR
LD
LD DRIVE CIRCUIT
76
75
71
78
LD DRIVE SIGNAL
70
MOTOR ROTATION POSITION
MOTOR DRIVE SIGNAL
LASER RADER CPU
77
MOTOR DRIVE CIRCUIT
72
73
74
LIGHT-RECEIVING UNIT
PD
85
89
87
81
AMPLIFIER
TIME MEASURING CIRCUIT
MEASURED TIME
REFERENCE VOLTAGE
83
MEASUREMENT DATA
TO RECOGNITION/ INTER-VEHICLE CONTROL ECU 3

FIG. 2B

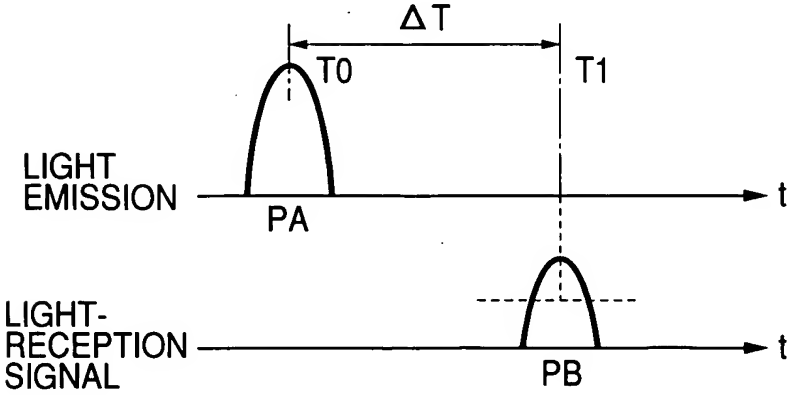
ΔT
T0
T1
LIGHT EMISSION
PA
t
LIGHT-RECEPTION SIGNAL
PB
t

FIG. 3

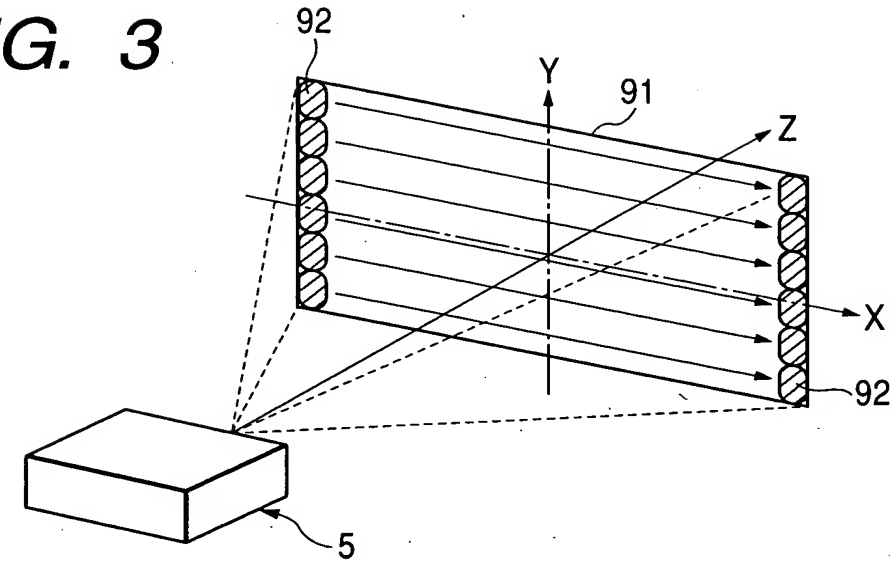
92
Y
91
Z
X
92
5

FIG. 4

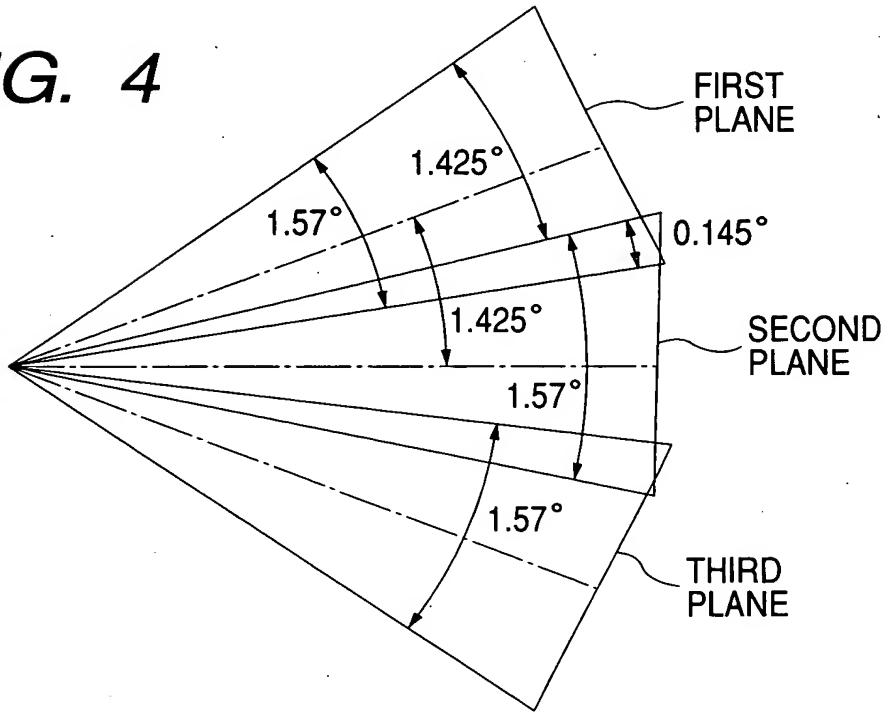
FIRST PLANE
1.425°
1.57°
0.145°
1.425°
SECOND PLANE
1.57°
1.57°
THIRD PLANE

FIG. 5

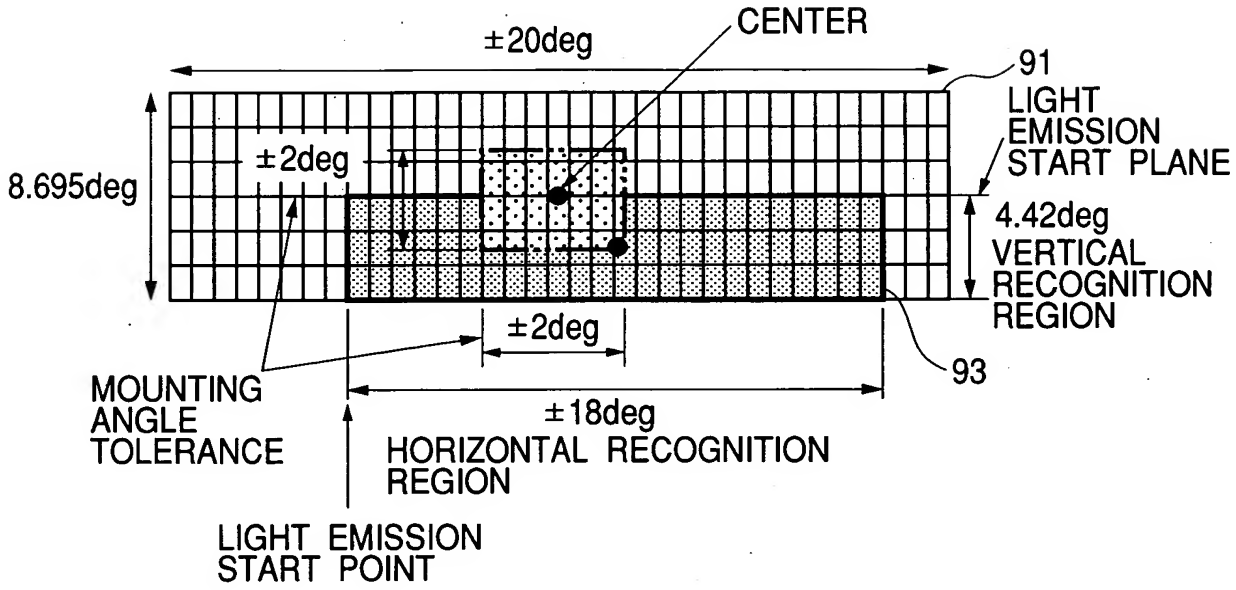
±20deg
CENTER
91
LIGHT EMISSION START PLANE
8.695deg
±2deg
4.42deg
VERTICAL RECOGNITION REGION
±2deg
93
MOUNTING ANGLE TOLERANCE
±18deg
HORIZONTAL RECOGNITION REGION
LIGHT EMISSION START POINT

FIG. 6

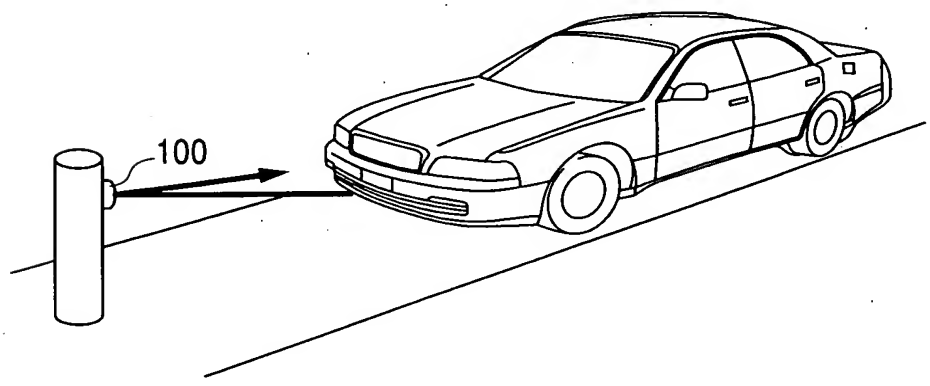
100

FIG. 7

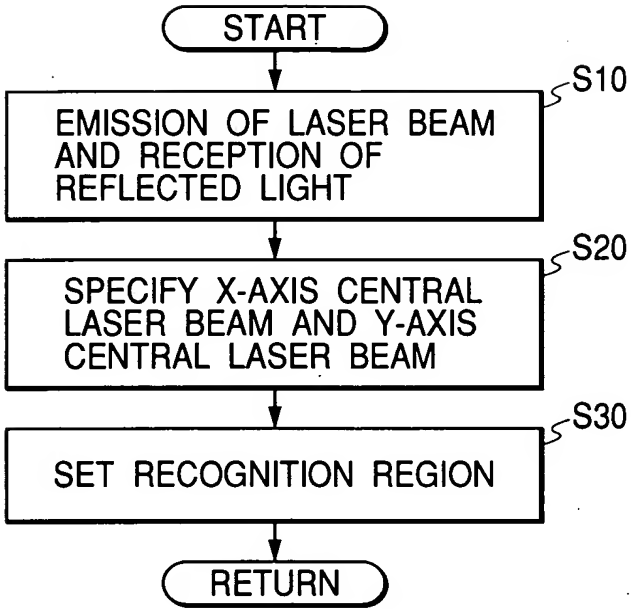
START
S10
EMISSION OF LASER BEAM AND RECEPTION OF REFLECTED LIGHT
S20
SPECIFY X-AXIS CENTRAL LASER BEAM AND Y-AXIS CENTRAL LASER BEAM
S30
SET RECOGNITION REGION
RETURN

FIG. 8

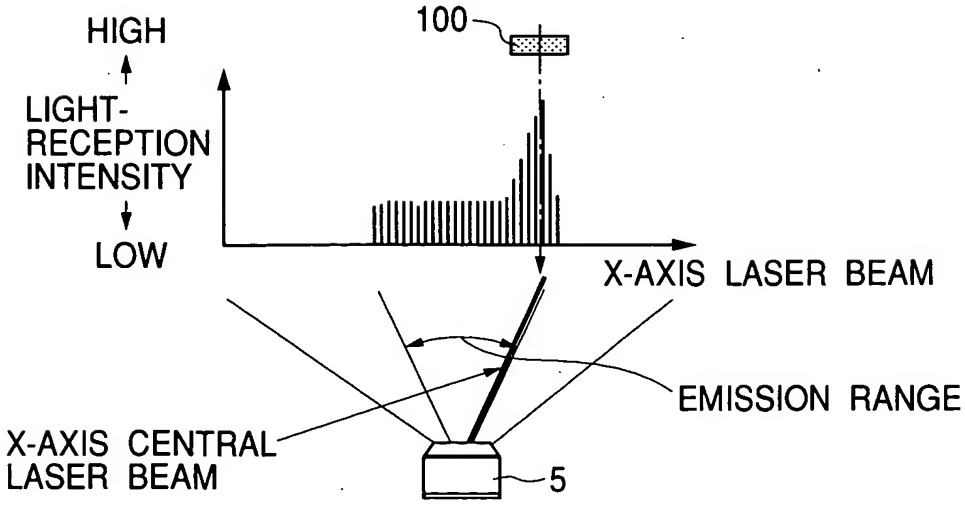
HIGH
LIGHT-RECEPTION INTENSITY
LOW
100
X-AXIS LASER BEAM
EMISSION RANGE
X-AXIS CENTRAL LASER BEAM
5

FIG. 9

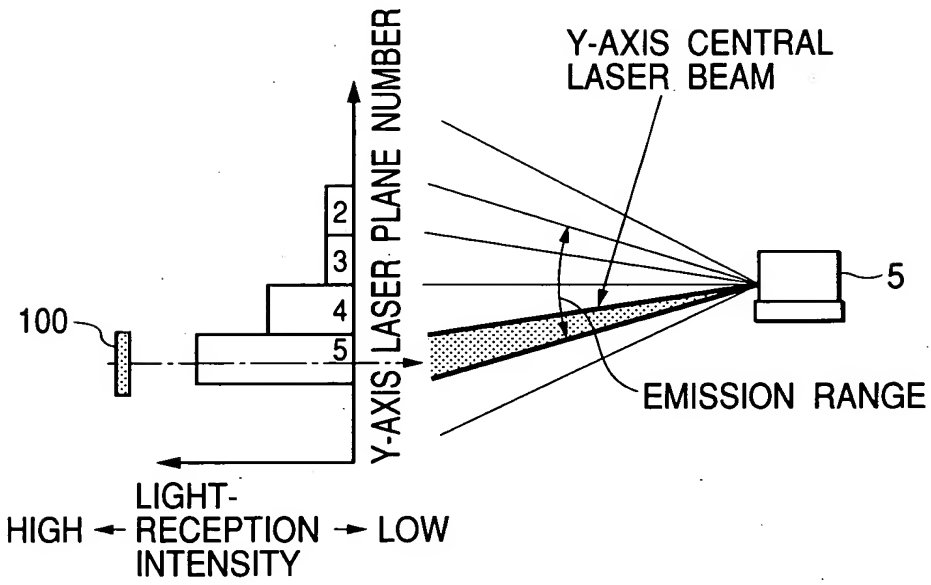
Y-AXIS LASER PLANE NUMBER
Y-AXIS CENTRAL LASER BEAM
2
3
4
5
100
5
EMISSION RANGE
LIGHT-RECEPTION INTENSITY
HIGH
LOW

FIG. 10

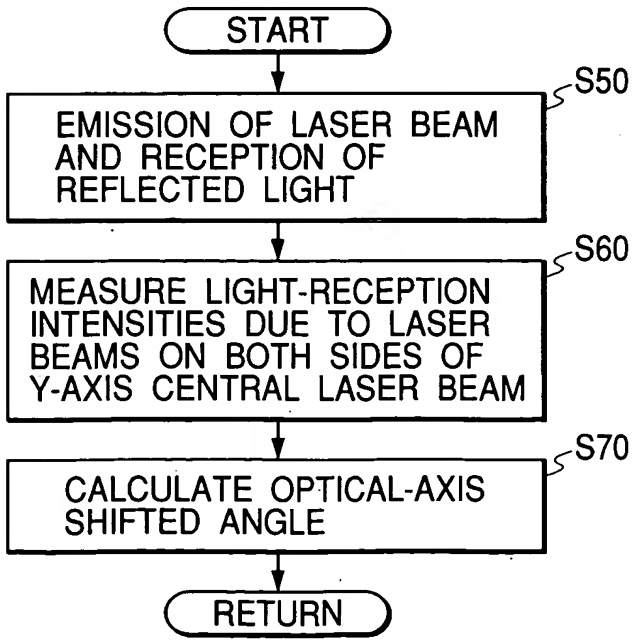
START
S50
EMISSION OF LASER BEAM AND RECEPTION OF REFLECTED LIGHT
S60
MEASURE LIGHT-RECEPTION INTENSITIES DUE TO LASER BEAMS ON BOTH SIDES OF Y-AXIS CENTRAL LASER BEAM
S70
CALCULATE OPTICAL-AXIS SHIFTED ANGLE
RETURN

FIG. 11

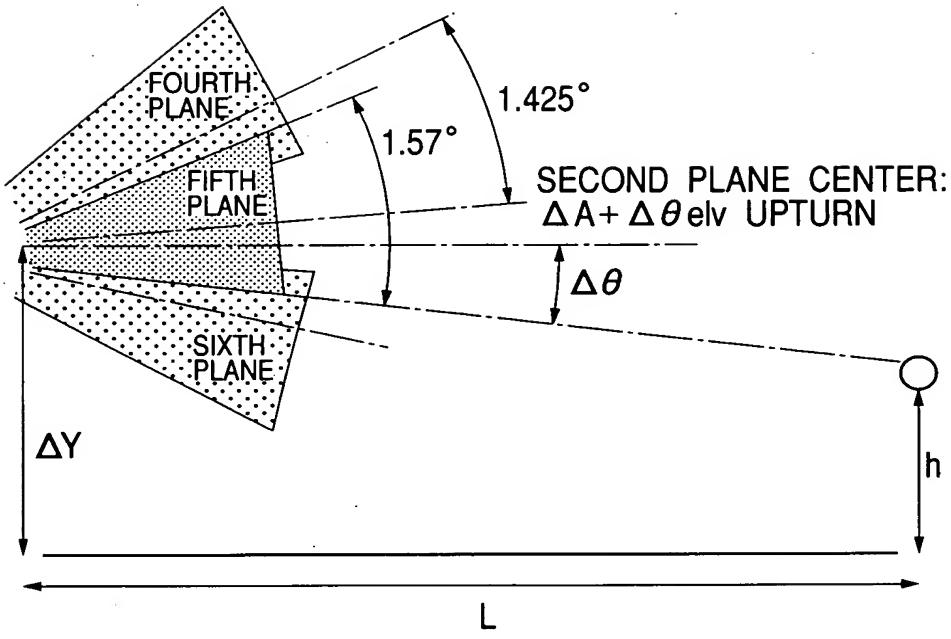
FOURTH PLANE
FIFTH PLANE
SIXTH PLANE
1.425°
1.57°
SECOND PLANE CENTER:
ΔA+Δθelv UPTURN
Δθ
ΔY
h
L

FIG. 12

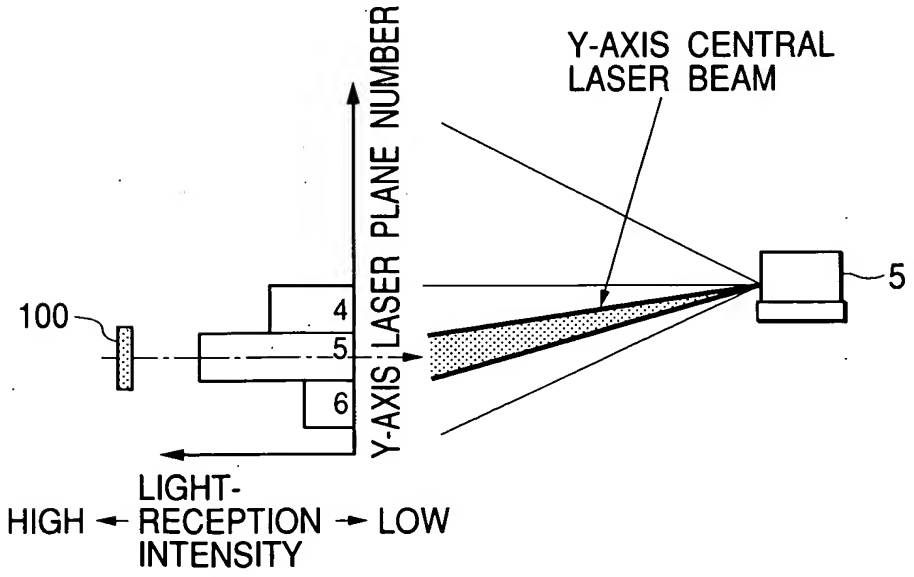
Y-AXIS LASER PLANE NUMBER
Y-AXIS CENTRAL LASER BEAM
100
4
5
6
5
HIGH ← LIGHT-RECEPTION INTENSITY → LOW

FIG. 13A

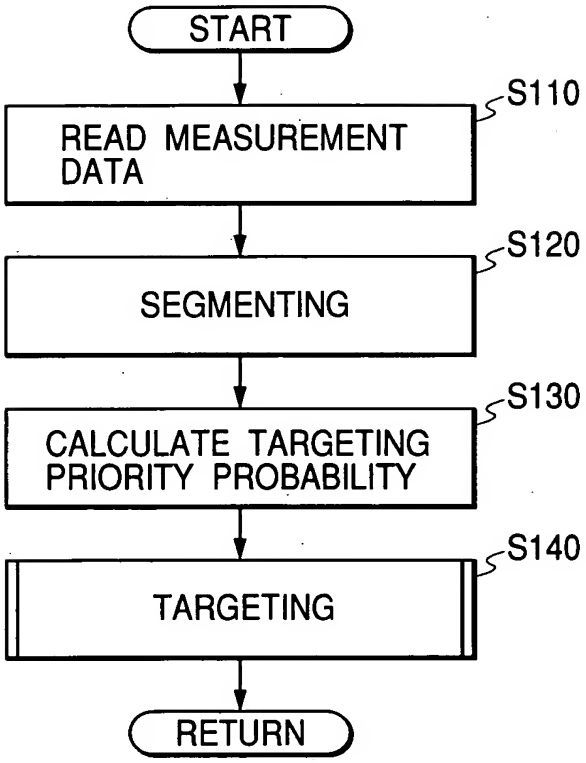

FIG. 13B

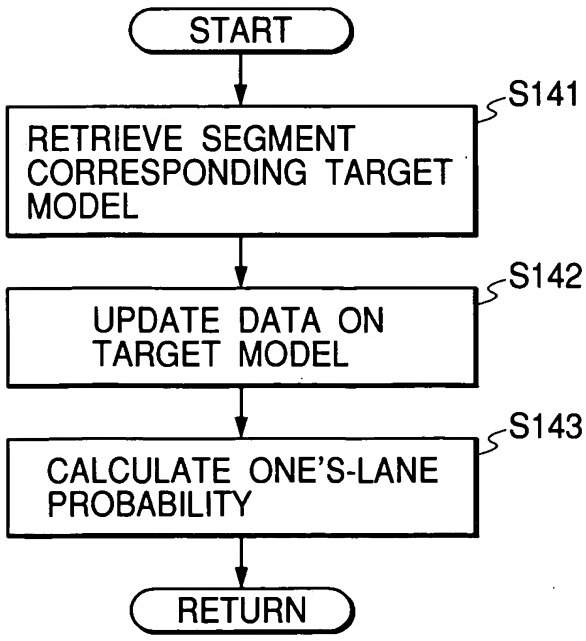

FIG. 14

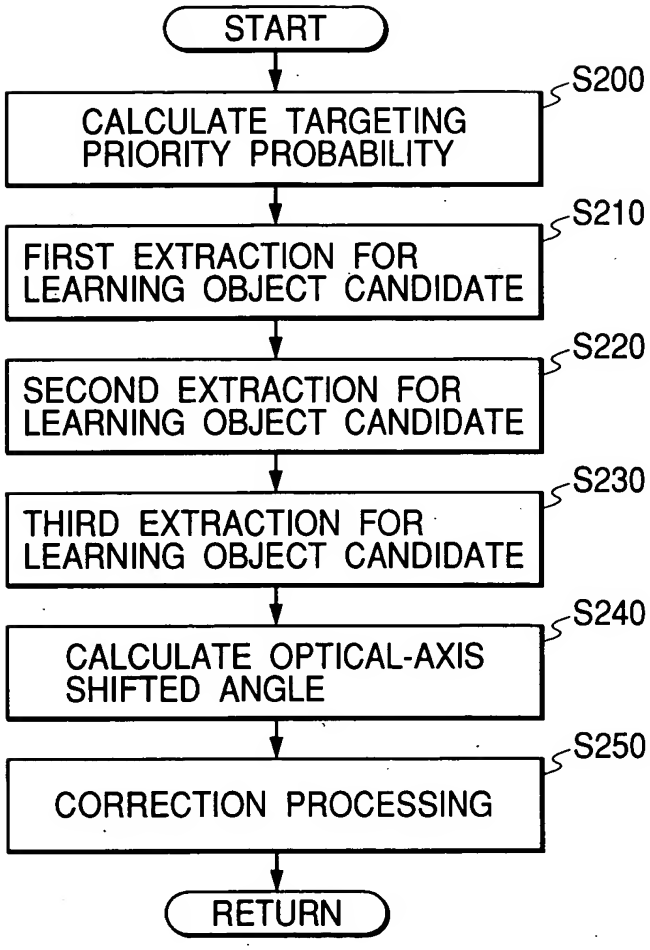
START
CALCULATE TARGETING PRIORITY PROBABILITY
S200
FIRST EXTRACTION FOR LEARNING OBJECT CANDIDATE
S210
SECOND EXTRACTION FOR LEARNING OBJECT CANDIDATE
S220
THIRD EXTRACTION FOR LEARNING OBJECT CANDIDATE
S230
CALCULATE OPTICAL-AXIS SHIFTED ANGLE
S240
CORRECTION PROCESSING
S250
RETURN

FIG. 15

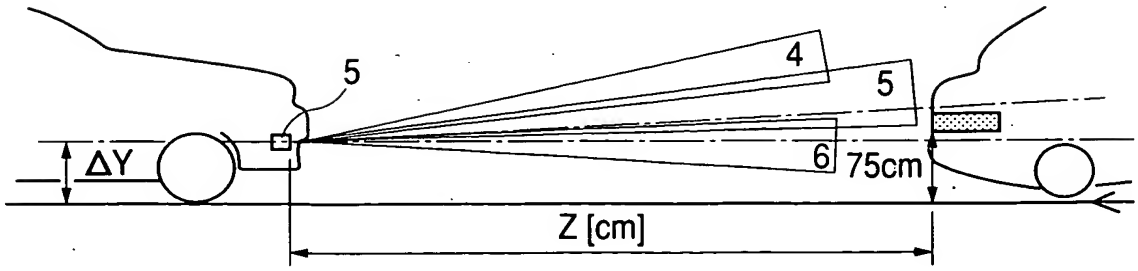
5
4
5
6
75cm
ΔY
Z [cm]

FIG. 16

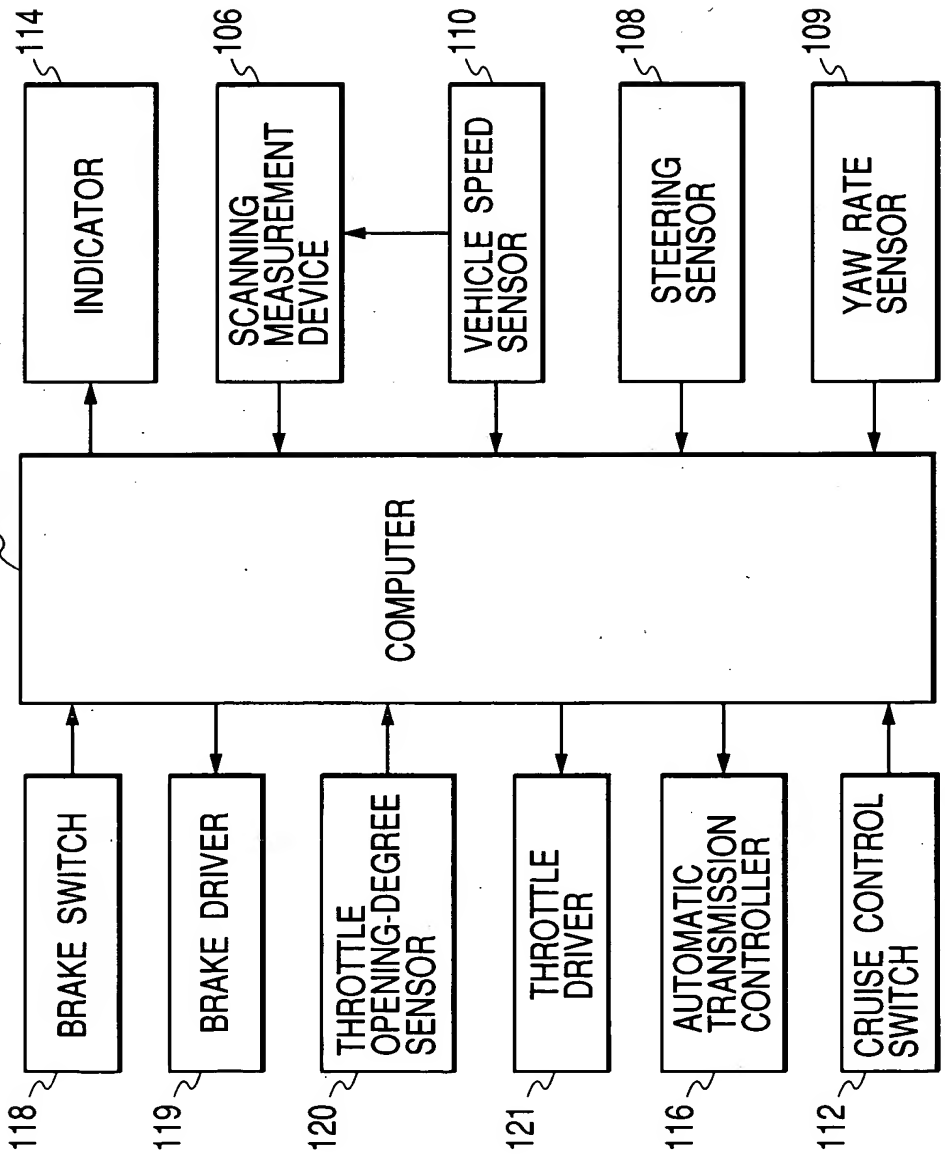
102
104
COMPUTER
114
INDICATOR
106
SCANNING MEASUREMENT DEVICE
110
VEHICLE SPEED SENSOR
108
STEERING SENSOR
109
YAW RATE SENSOR
118
BRAKE SWITCH
119
BRAKE DRIVER
120
THROTTLE OPENING-DEGREE SENSOR
121
THROTTLE DRIVER
116
AUTOMATIC TRANSMISSION CONTROLLER
112
CRUISE CONTROL SWITCH

FIG. 17

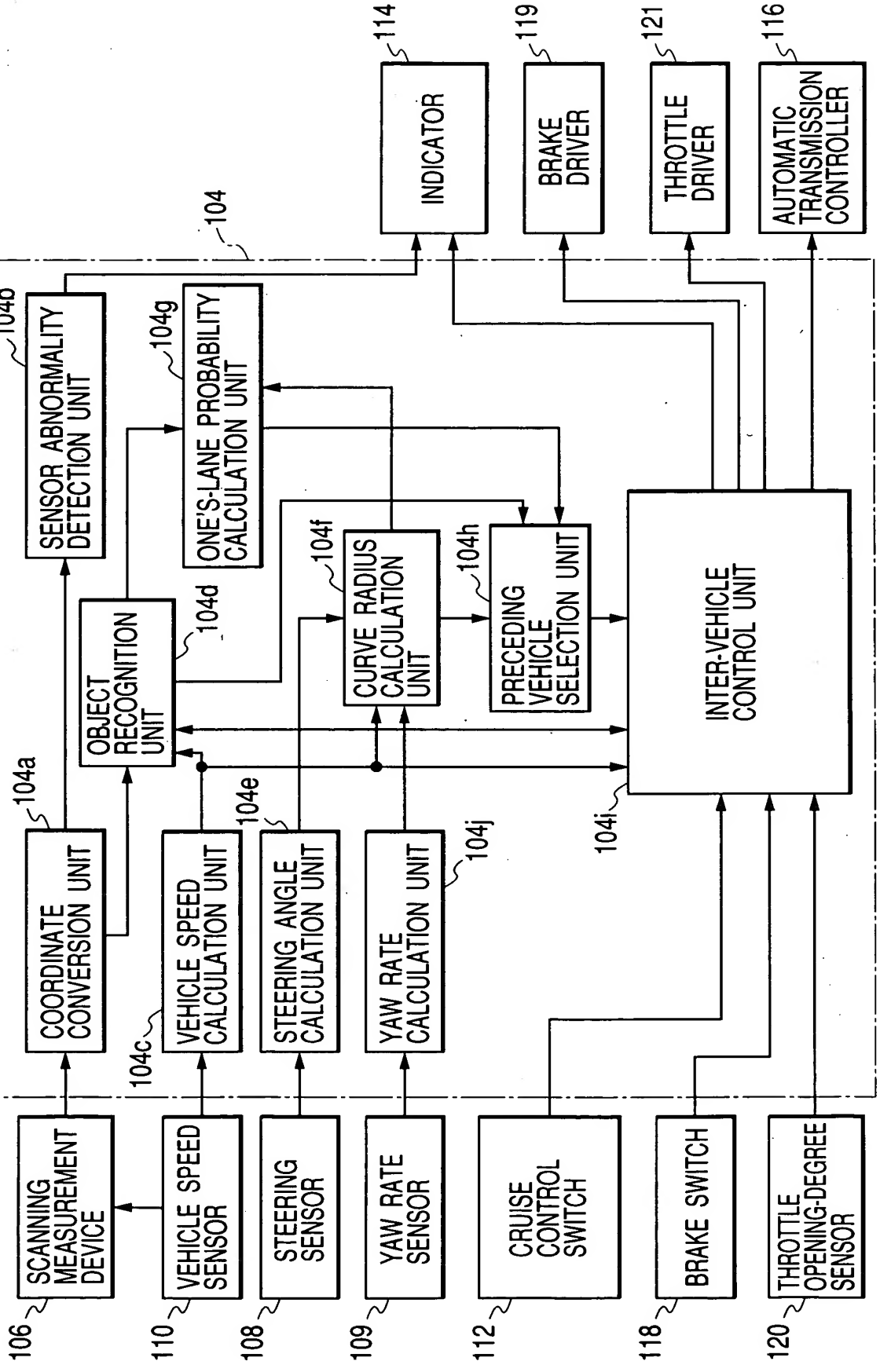
104
SCANNING MEASUREMENT DEVICE
106
VEHICLE SPEED SENSOR
110
STEERING SENSOR
108
YAW RATE SENSOR
109
CRUISE CONTROL SWITCH
112
BRAKE SWITCH
118
THROTTLE OPENING-DEGREE SENSOR
120
COORDINATE CONVERSION UNIT
104a
VEHICLE SPEED CALCULATION UNIT
104c
STEERING ANGLE CALCULATION UNIT
104e
YAW RATE CALCULATION UNIT
104j
SENSOR ABNORMALITY DETECTION UNIT
104b
OBJECT RECOGNITION UNIT
104d
ONE'S-LANE PROBABILITY CALCULATION UNIT
104g
CURVE RADIUS CALCULATION UNIT
104f
PRECEDING VEHICLE SELECTION UNIT
104h
INTER-VEHICLE CONTROL UNIT
104i
INDICATOR
114
BRAKE DRIVER
119
THROTTLE DRIVER
121
AUTOMATIC TRANSMISSION CONTROLLER
116

FIG. 18

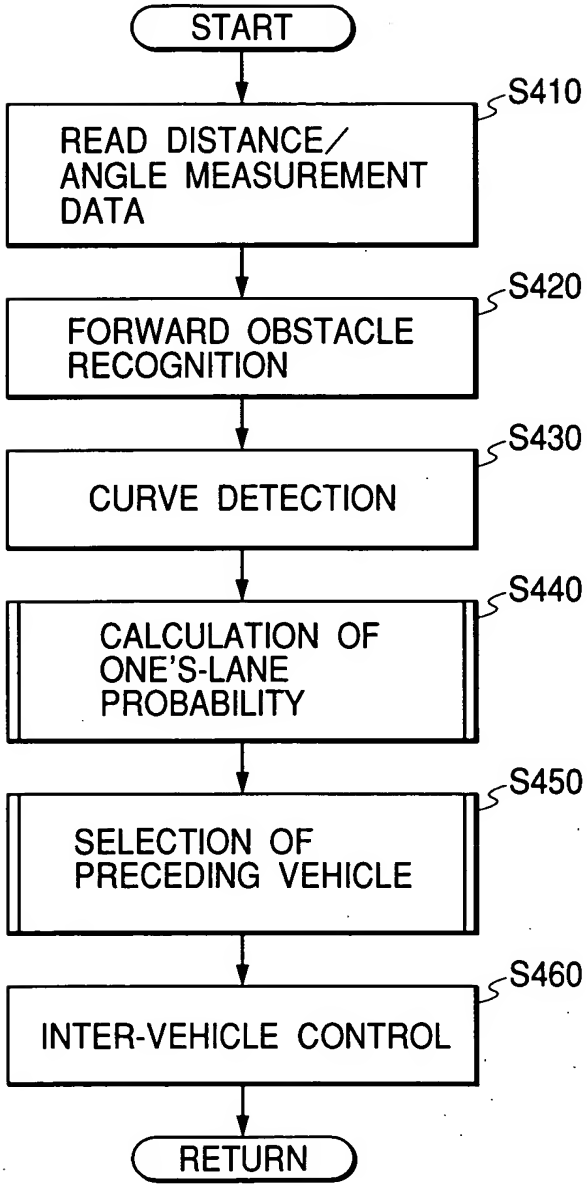
START
S410
READ DISTANCE/ ANGLE MEASUREMENT DATA
S420
FORWARD OBSTACLE RECOGNITION
S430
CURVE DETECTION
S440
CALCULATION OF ONE'S-LANE PROBABILITY
S450
SELECTION OF PRECEDING VEHICLE
S460
INTER-VEHICLE CONTROL
RETURN

FIG. 19

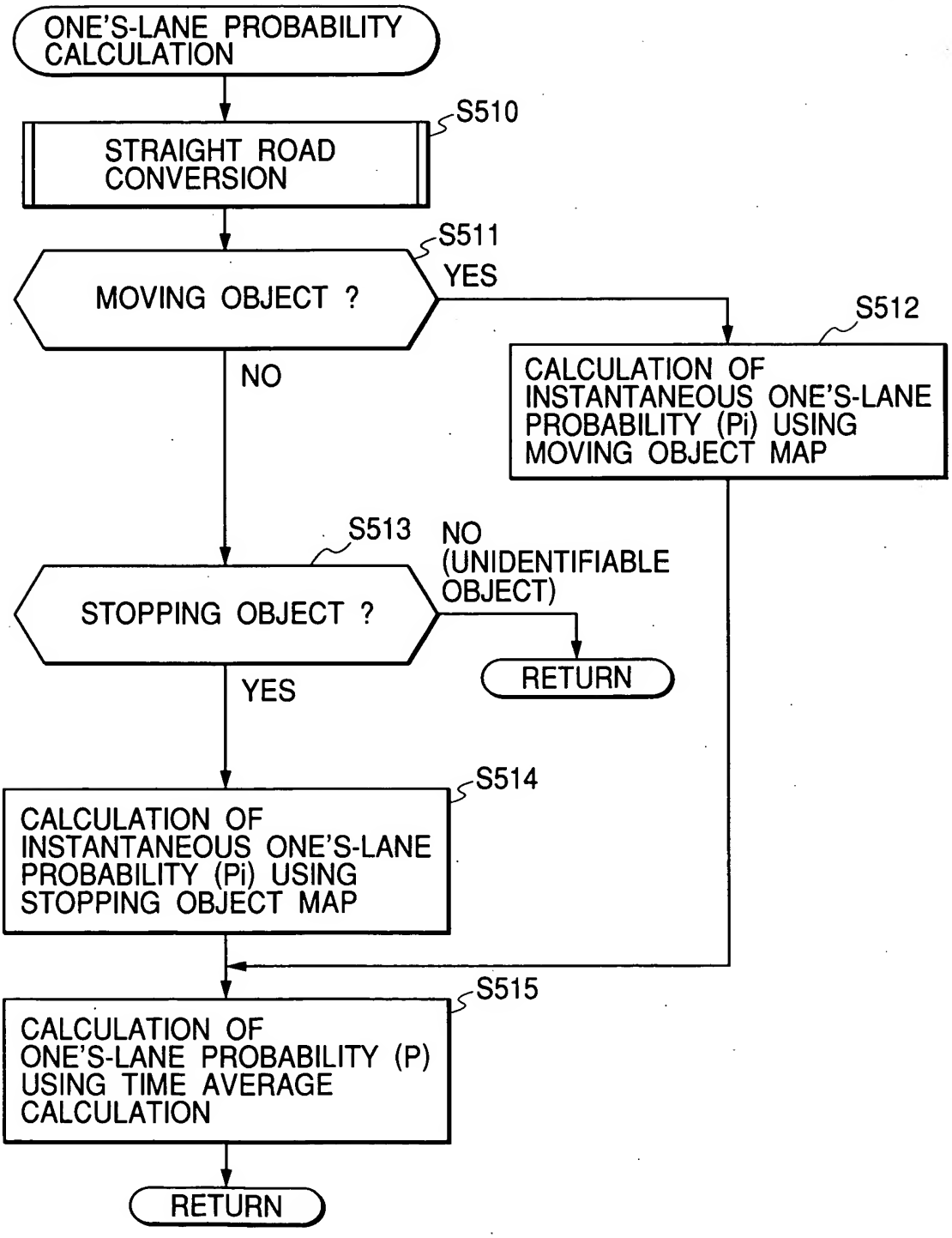
ONE'S-LANE PROBABILITY CALCULATION
S510
STRAIGHT ROAD CONVERSION
S511
MOVING OBJECT ?
YES
S512
CALCULATION OF INSTANTANEOUS ONE'S-LANE PROBABILITY (Pi) USING MOVING OBJECT MAP
NO
S513
STOPPING OBJECT ?
NO (UNIDENTIFIABLE OBJECT)
RETURN
YES
S514
CALCULATION OF INSTANTANEOUS ONE'S-LANE PROBABILITY (Pi) USING STOPPING OBJECT MAP
S515
CALCULATION OF ONE'S-LANE PROBABILITY (P) USING TIME AVERAGE CALCULATION
RETURN

FIG. 20

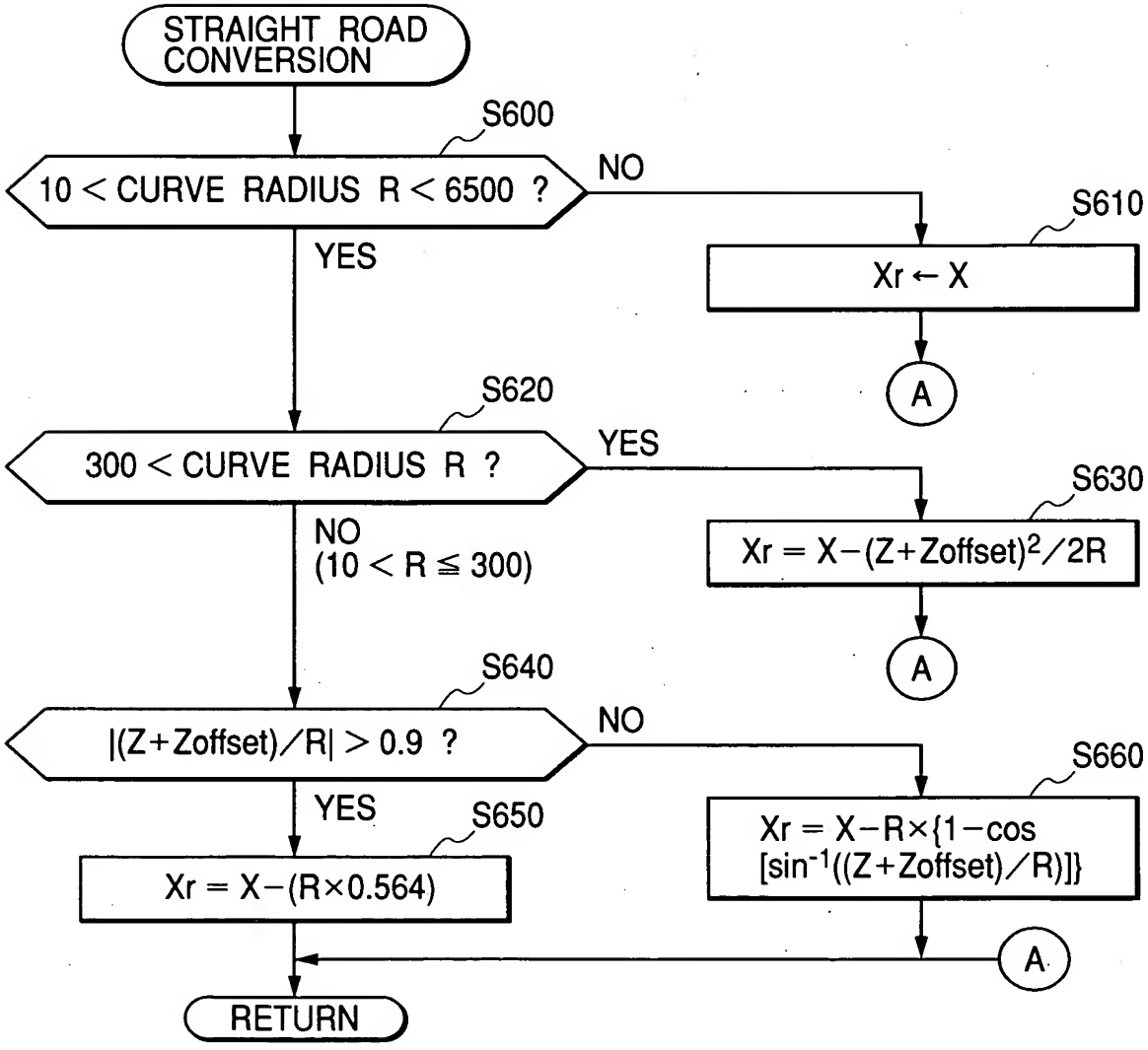
STRAIGHT ROAD CONVERSION
S600
10 < CURVE RADIUS R < 6500 ?
NO
YES
S610
Xr ← X
A
S620
300 < CURVE RADIUS R ?
YES
NO
(10 < R ≦ 300)
S630
Xr = X−(Z+Zoffset)²/2R
A
S640
|(Z+Zoffset)/R| > 0.9 ?
NO
YES
S650
Xr = X−(R×0.564)
S660
Xr = X−R×{1−cos [sin⁻¹((Z+Zoffset)/R)]}
A
RETURN

FIG. 21

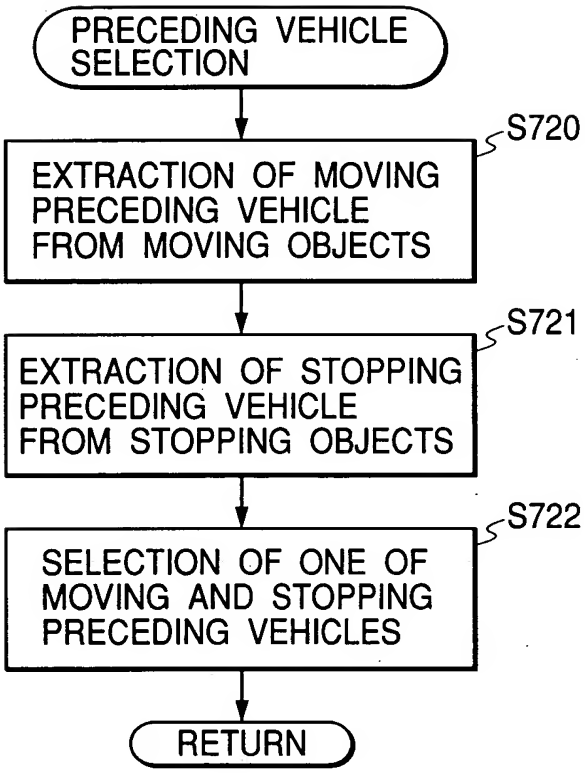
PRECEDING VEHICLE SELECTION
S720
EXTRACTION OF MOVING PRECEDING VEHICLE FROM MOVING OBJECTS
S721
EXTRACTION OF STOPPING PRECEDING VEHICLE FROM STOPPING OBJECTS
S722
SELECTION OF ONE OF MOVING AND STOPPING PRECEDING VEHICLES
RETURN

FIG. 22

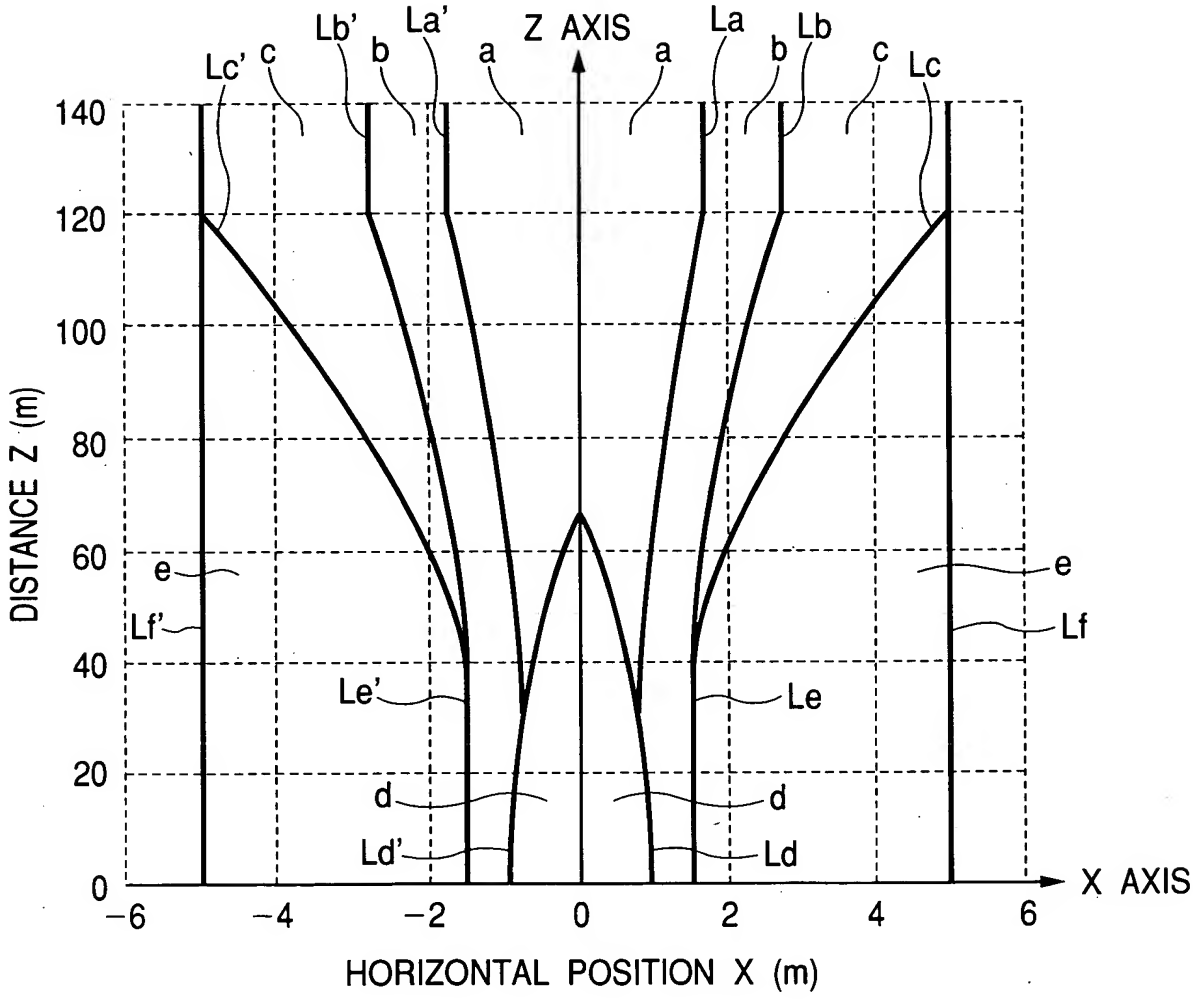
Z AXIS
Lc'
c
Lb'
b
La'
a
a
La
b
Lb
c
Lc
140
120
100
80
60
40
20
0
DISTANCE Z (m)
e
Lf'
Le'
d
Ld'
e
Lf
Le
d
Ld
X AXIS
−6
−4
−2
0
2
4
6
HORIZONTAL POSITION X (m)

FIG. 23

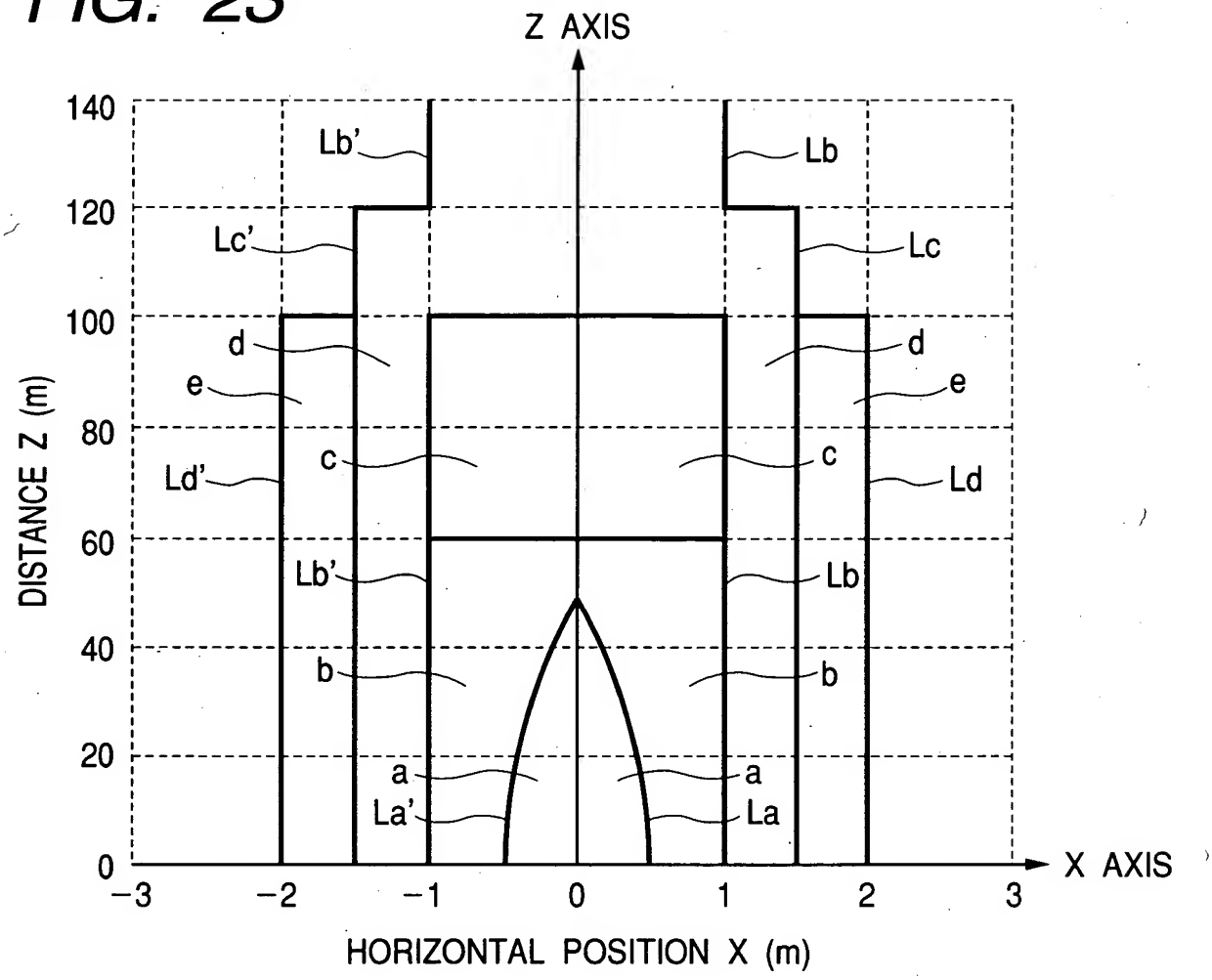

FIG. 24

Mark	Area	Conditions	Instantaneous Probability Pi (%)
①	d	having area even if only slightly	100
②	a	center exists in area	80
③	b	center exists in area	60
④	c	center exists in area	30
⑤	e	center exists in area	10
⑥	not satisfying all conditions 1 to 5		0

HIGH
PRIORITY
LOW

FIG. 25

Mark	Area	Distance (m)	Conditions	Instantaneous Probability Pi (%)
①	a	0～50	having area even if only slightly	100
②	b	0～60	center exists in area	80
③	c	61～100	center exists in area	60
④	d	0～140	center exists in area	40
⑤	e	0～100	center exists in area	10
⑥	not satisfying all conditions 1 to 5			0

HIGH
PRIORITY
LOW

FIG. 26

Distance (m)	Wave (Load Average Value)
100 or more	0.96
20 to less than 40	0.87
10 to less than 20	0.85
less than 10	0.75
others	$0.87+(0.96-0.87)\times(Z-40)/(100-40)$
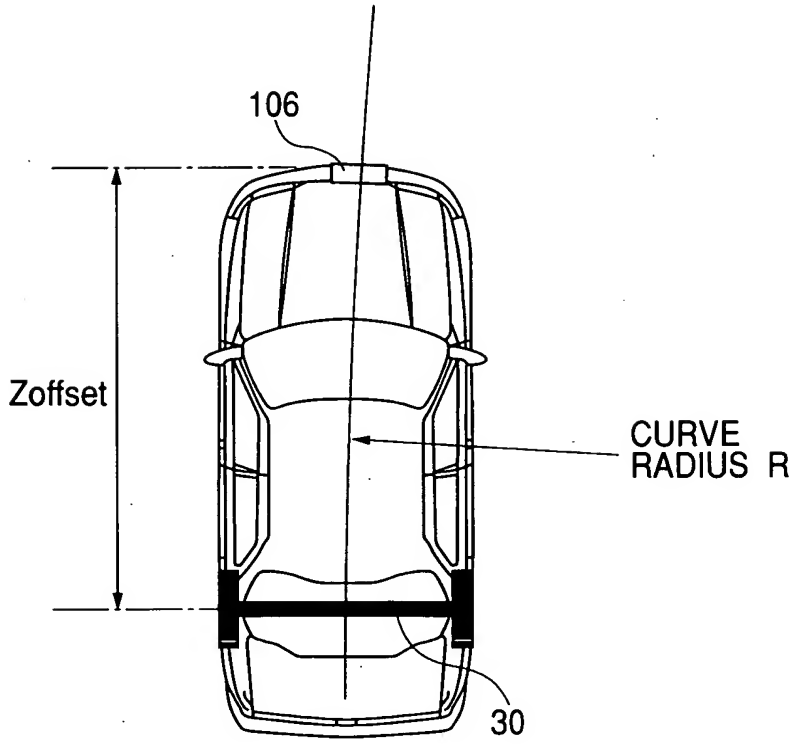
FIG. 27